LaRC Facilities and Laboratories

- **Transonic Dynamics Wind Tunnel**
  - Only facility in the world capable of performing tests of scaled aeroelastic models at transonic speeds. Operating characteristics and use of heavy gas as a test medium unique in the world. Used in U.S. to clear aircraft for flutter.
- **Aircraft Landing Dynamics Facility**
  - Unique facility uses high pressure waterjet to accelerate a test carriage to maximum speeds of 220 knots for testing tires, braking systems, and runway surface treatments. Facility also includes a research laboratory with specialized test capability for the study of landing gear, tires, and runway friction. Most major airframers and tire manufacturers use test results to optimize ground performance.
- **Structures and Materials Laboratory**
  - Specially designed 120 Kip, 300 Kip, and 1,200 kip test machines for precision compression testing; high bay area with large platen for testing structural components
- **Combined Loads Test Facility**
  - Combined mechanical, pressure, and thermal loading capability that simulates subsonic and supersonic flight load conditions on transport wing and fuselage structures
- **Structural Dynamics Laboratory**
  - Three laboratories specifically designed for structural dynamics and pointing control research on aerospace structures and components.
- **Thermal Structures Laboratory**
  - Conducts a broad range of tests to characterize the behavior of advanced thermal structures subjected to combined thermal and mechanical loading conditions.
- **Fatigue and fracture laboratory**
  - Capability to characterize materials nonlinear stress-strain behavior; yield and ultimate strength of metals for uniaxial and biaxial stresses; fatigue life, fatigue crack growth, thermomechanical fatigue, and crack growth in ultra-high vacuum, inert gases, and salt water; fracture toughness; damage mechanisms and progressive failure of composites; elevated temperature creep, mechanical testing for combined tension/torsion, tension/bending, and in-plane biaxial loading condition.

LaRC Facilities and Laboratories, continued

- **Polymer synthesis and composites fabrication laboratory**
  - Synthesis and processing of novel polymers, adhesives, functional and smart polymers; computational materials, and polymer matrix composites; advanced composite fabrication including tape layup prepreg, powder coated towpreg, textile preforms and resin film infusion; and adhesives development and characterization.
- **Carbon-carbon research laboratory**
  - Complete processing capabilities for fabricating carbon-carbon composites and ceramic-composites, coatings deposition by chemical vapor deposition, pack cementation conversion, sol gel processing, graphitization and high-temperature heat treating to 2900 F, isothermal oxidation exposure testing of materials, mechanical property measurements, and ultra-high temperature materials exposure in high heat flux facility with black-body source to 6500K
- **Light alloy synthesis, forming, and joining technology laboratory**
  - Alloy synthesis, processing, and joining and comprehensive physical, chemical, and metallurgical analysis capabilities to develop advanced aluminum, aluminum-lithium, titanium, and metal matrix composites; facilities include metallography, optical microscopy, and electron optics for transmission, scanning, and microprobe analysis and crystallography; x-ray diffraction lab for phase identification, texture, and residual stress; synthesis and processing labs include vacuum hot press, hot isostatic press, plasma deposition, and physical and chemical vapor deposition.
- **Smart materials and superconductivity laboratory**
  - Ceramics and ceramic thin-film processing, piezoelectric materials development and characterization, piezoelectric actuator device development and performance testing, superconductivity materials development and characterization (current density vs. temperature, durability), class 100 clean room
- **Materials characterization and dimensional stability laboratories**
  - Capabilities include ultraviolet, visible, and infrared spectroscopy, outgassing measurements, mass spectrometers for analysis of volatile products from materials, glass transition temperature measurements, electron paramagnetic resonance spectroscopy for characterizing degradation mechanisms, specimen conditioning ovens, mechanical property measurements, cryogenic exposures, thermal expansion measurements with resolution to 0.5 ppm, and surface accuracy measurements on reflector panels.
- **Nondestructive evaluation sciences laboratory**
  - Advanced sensor technologies and signal processing software are being developed for ultrasonics, thermal, optical, electromagnetic, acoustic emission, x-ray radiography, computer aided tomography, and fiber optics with a fiber draw tower.

Structures & Materials Facilities at the NASA Langley Research Center

http://smc.larc.nasa.gov

Areas of Expertise

-From materials synthesis to large scale structural validation-

AoE1: Materials synthesis & processing

AoE 2: Analytical and computational methods

AoE3: Structural concepts, behavior, durability, & damage tolerance

AoE 4: Nondestructive evaluation

AoE5: Structural dynamics & landing dynamics

AoE6: Aeroelasticity & unsteady aerodynamics

AoE7: Experimental methods & laboratory operations

Structures & Materials Facilities and Labs

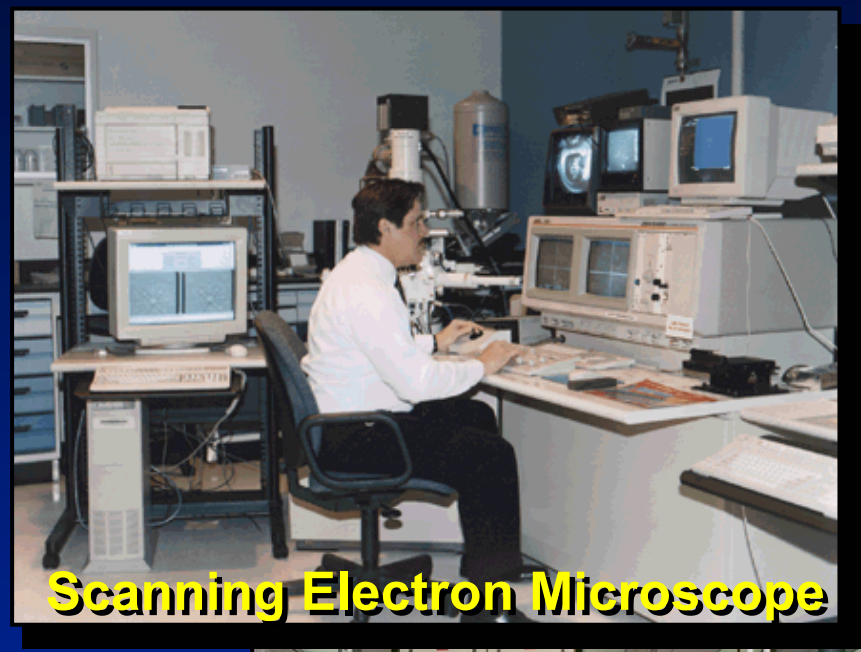
- Composite and Polymers Laboratory (AoE #1)
- Light Alloy Laboratory (AoE #1)
- Immersive Design and Simulation Laboratory (AoE #2)
- Materials Research Laboratory (AoE #1 , #3)
- Structures & Materials Laboratory (AoE #1, #3)
- Combined Loads Test System Facility (AoE #3)
- Thermal Structures Laboratory (AoE #3)
- Hazardous Test Facility (AoE #3)
- Nondestructive Evaluation Laboratory (AoE #4)
- Aircraft Landing Dynamics Facility (AoE #5)
- Structural Dynamics Laboratory (AoE #5)
- Transonic Dynamics Tunnel (AoE #6)
- Rotorcraft Hover Test Facility (AoE #6)

Composites and Polymers Laboratory (AoE #1)

- 20,000 ft^2 facility, 8 polymer synthesis laboratories with 16 chemical fume hoods
- Three polymer characterization labs for complete spectrum of thermal, molecular weight and mechanical properties can be determined
- Processing equipment includes two autoclaves, a modular prepreg machine, a powder-coating facility, and an adhesive bonding laboratory

Light Alloy Laboratory (AoE #1)

- Metals Processing
  - Plasma Spray
  - Advanced Metals Joining
- Metallurgical Analysis
  - Optical Metallography
  - X-ray Diffraction Analysis
  - Scanning Electron Microscope
  - Thermal Analysis
  - Failure Analysis
- Mechanical Testing
  - Tensile/Compression
  - Fatigue
  - Fracture Toughness
  - Creep
  - Biaxial Tension


Scanning Electron Microscope


Plasma Spray

Immersive Design and Simulation Lab (AoE #2)

- Focus: Immersive, multi-sensory, multidisciplinary simulation, design, and collaboration
- 4-wall Cave Automated Virtual Environment (CAVE)
- ImmersaDesk R2
- 16-processor, 4-pipe Onyx2
- Positional sound rendering hardware/software

Materials Research Laboratory (AoE #1 and #3)

- Focus: Advanced structural materials under mechanical and thermal loads
- Deformation characteristics and damage mechanisms
- Testing Systems: 49 servohydraulic systems from 1 to 400 kips
- 13 high temperature creep frames
- 20 load frames for thermal and mechanical cyclic loading

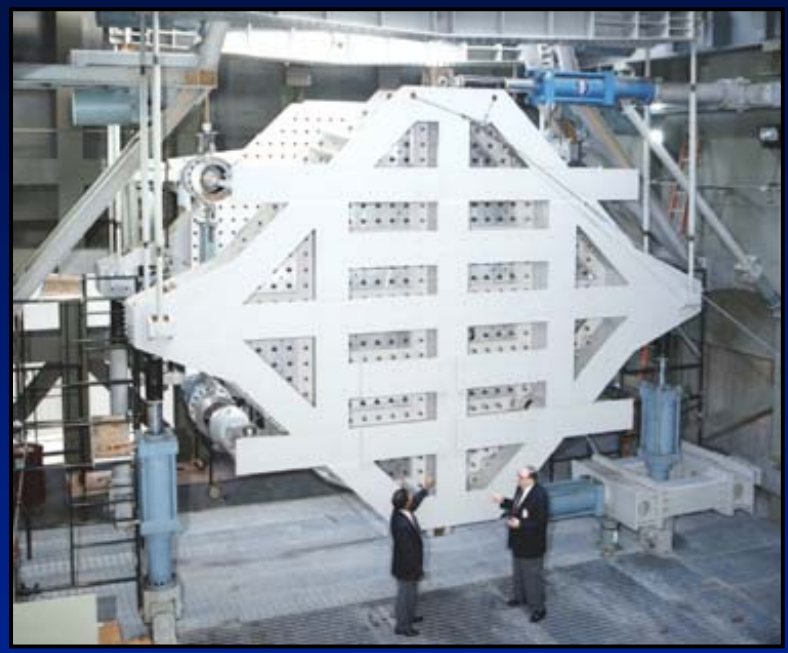
Structures and Materials Laboratory (AoE #1 and #3)

- Polymeric and metallic material characterization for environmental conditions
- Low-speed impact damage testing

- Structural testing machines
  - 1-kip to 1200-kip quasi-static loading
  - 25-kip fatigue loading
- Rigid back stop for full-scale structural testing
- Combined loads test machine for shells up to 36-inches diameter
- High-speed data acquisition system (2-min. data block, 36 channels at 10^6 s/sec)
- Modular data acquisition systems (>2000 channels at 20K s/sec)
- Specimen full-field displacement and strain measurement systems

Combined Loads Test System Facility (AoE #3)

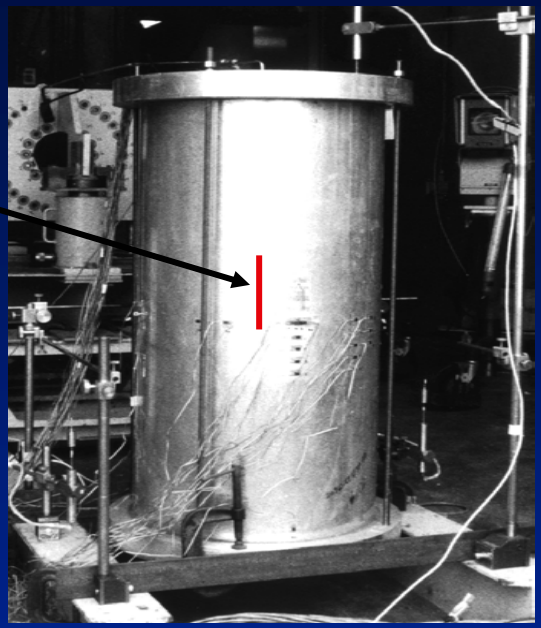
- Combined axial, shear, and internal pressure loading on curved panels
- Axial loads to 2,700 kips
- Shear loads to 600 kips
- Torsion loads from 300 kips actuators
- Internal pneumatic pressure to 20 psig
- Cylindrical structures to 15 feet diameter
- Temperature to 400° F
- Test structures length to 45 feet
- Curved panels to 125 inches radius, 96 inches wide, and 120 inches long



Thermal Structures Laboratory (AoE #3)

- Focus: Characterize the behavior of advanced thermal structures subject to combined thermal and mechanical loads
- Test systems include seven servo hydraulic test machines ranging from 22 to 500 kips
- Thermal loads can be applied from -420°F to 2500°F
- Thermal characterization using thermal vacuum chamber and optical/contact techniques

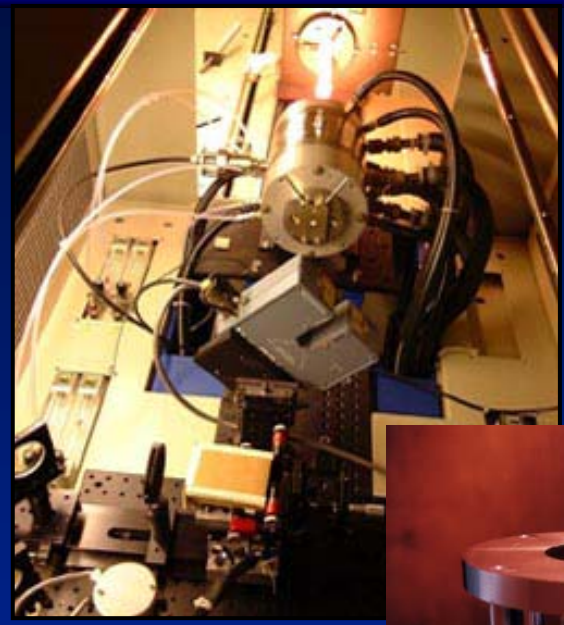
Hazardous Testing Facility (AoE #3)



- High-energy specimen penetration system
- Pressurized structural burst testing
- Structural explosive blast testing

Nondestructive Evaluation Laboratory (AoE #4)

- Focus: Development of new NDE measurement technologies, autonomous NDE systems, and integrated health management systems that ensure material and structural resilience, and that retard and reverse vehicle aging
- NDE technologies
  - Fiber Optic Sensors
  - Integrated Vehicle Health Monitoring
  - Nano- and Micro-Sensor Systems
  - Autonomous Measurement Systems



Fiber Optic Sensor Draw Tower

Rotating Self-Nulling Eddy Current Probe

Aircraft Landing Dynamics Facility (AoE #5)

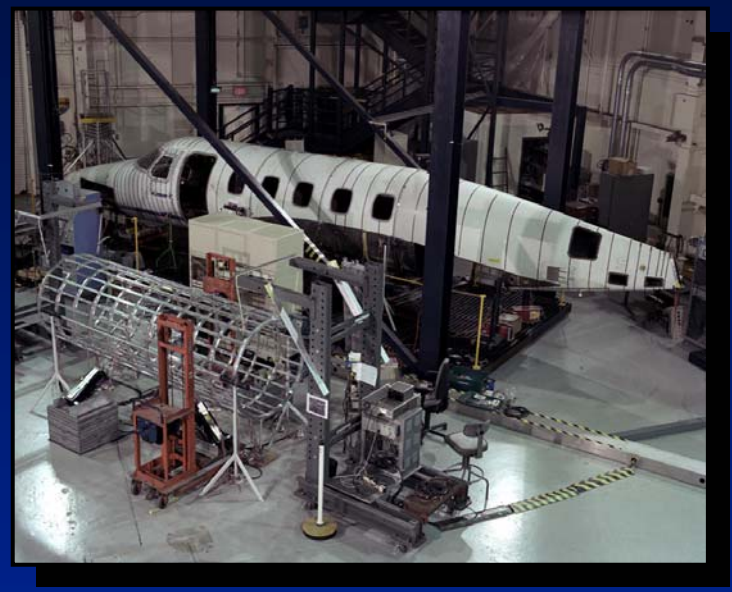
- Carriage Test Speed - 220 knots maximum
- Test Carriage 120,000 lb - 20 G acceleration
- Max. Vertical Load on test article - 70,000 lb
- Track Length - 2800 feet
- Yaw Angle - adjustable

Structural Dynamics Laboratory (AoE #5)

Focus: Advanced Modal test and active vibration control experiments

Experimental Facilities

- High bay, 5200 sq feet, 80 feet high with an overhead platform 73 feet above the floor. Extremely large data acquisition system for dynamic testing and signal processing
- The 16 meter Thermal Vacuum Chamber with centrifuge
- Backstop Lab with 38 feet vertical backstop and 12 x 12 feet by 95 feet high tower



Transonic Dynamics Tunnel (AoE #6)

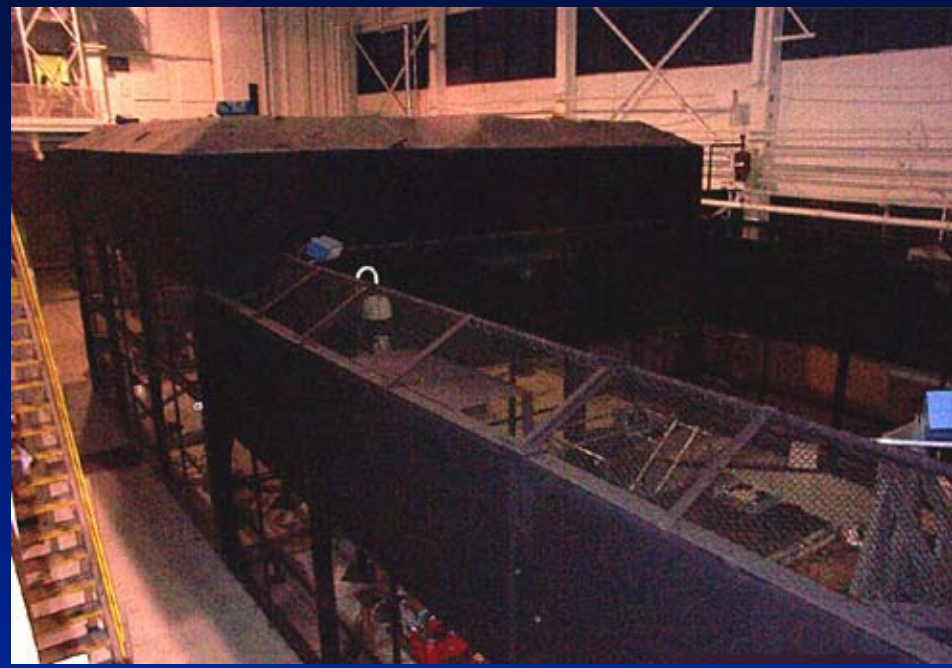
- Large, closed-circuit, continuous-flow, single-return wind tunnel
- Test Section - 16 feet square
- Flow medium - air or heavy gas (R-134a)
- Mach number range: 0 to 1.2
- Total pressure range: 0.01 to 1.0 atmosphere

A Unique National Facility Dedicated to Identifying, Understanding, and Solving Relevant Aeroelastic Problems

- Flutter/Divergence/Buffet
- Active Controls (Aeroservoelasticity)
- Steady and Unsteady Aerodynamics, Gust Response
- Ground Wind Loads
- Tiltrotor and Helicopter Vibrations, Loads, Aeroelasticity, and Performance

Rotorcraft Hover Test Facility (AoE #6)

- Prepare rotorcraft models for testing in TDT
- Perform hover testing of rotors up to 10 ft in diameter and rotational speeds to 900 RPM
- Two test cells: one for helicopter systems, one for tiltrotor systems
- Fully integrated DAS capable of sampling 64 channels at over 1000 Hz



- Integrated hydraulic system capable of 3000 psi and high flow rates
- High-intensity strobe lights for rotor blade tracking